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(71) Applicant(s)
Fichtel & Sachs AG

(Incorporated in the Federal Republic of Germany)

62 Ernst-Sachs-strasse, Schweinfurt,
Federal Republic of Germany

(72) Inventor(s)
Herbert Voit
Wolfgang Grosspietsch
Boleslaw Tulaczko

(74) Agent and/or Address for Service
Barker, Brettell & Duncan
138 Hagley Road, Edgbaston, BIRMINGHAM,
B16 9PW, United Kingdom

(54) An adjustable clutch actuator with a restraining device that allows for clutch wear

(57) A hydraulic actuator for a motor vehicle friction clutch comprises an inner cylinder casing 1 and an outer cylinder casing 2 which define a chamber 18 for a piston 9. The piston 9 is guided within a guiding element 4 fitted into the outer cylinder casing 2. When the piston 9 moves axially to engage/disengage the clutch at least one restraining device 8 in the outer cylinder casing 2 is brought into engagement, eg by hydraulic pressure in chamber 18, with the guiding element 4 to hold it stationary relative to the outer cylinder casing 2. On depressurisation of the chamber 18 the restraining device 8 releases the guiding element 14. In this situation clutch wear results in the clutch springs axially displacing the piston 9 and, via shoulder 20, the guiding element 14 (see fig 2). The restraining device 8 may be a seal 5 having a radially pre-stressed sealing lip 7 which, when activated by hydraulic pressure, holds the guiding element 14 stationary.

Fig.1

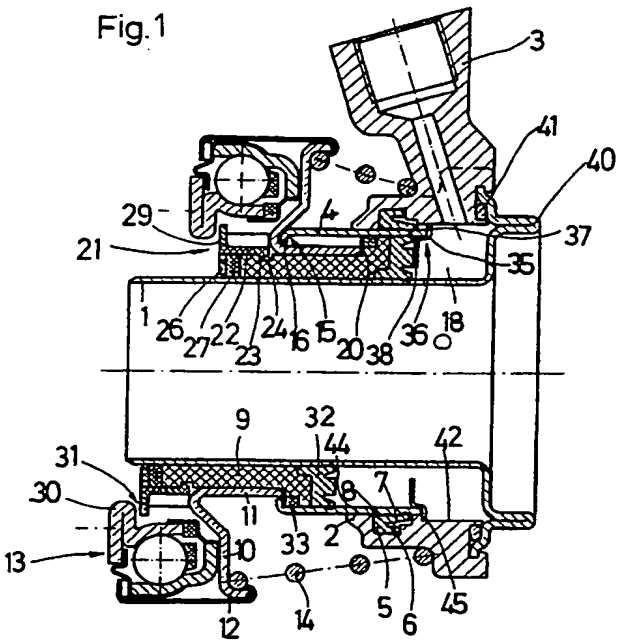

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Fig.1

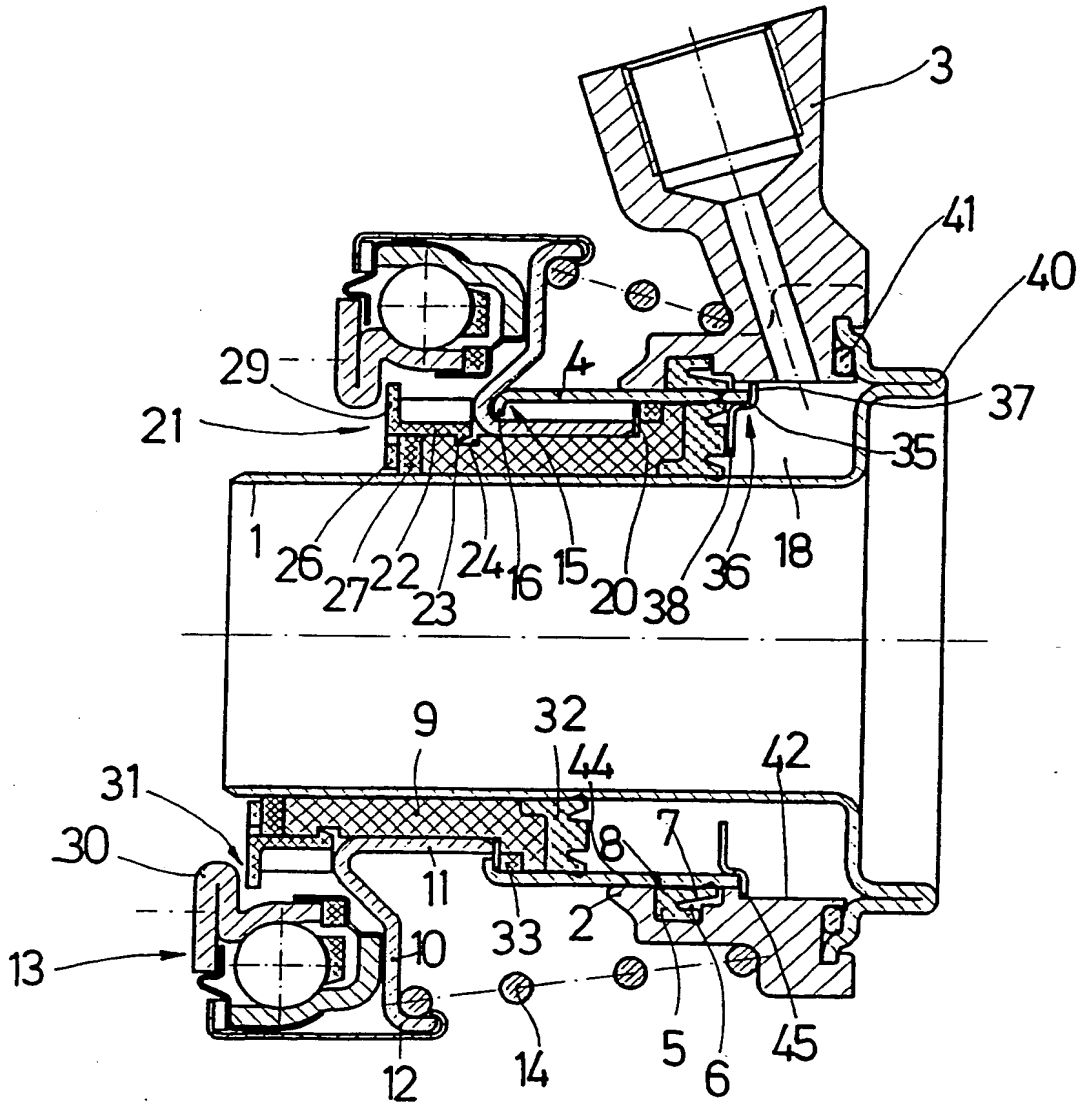
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Fig. 2

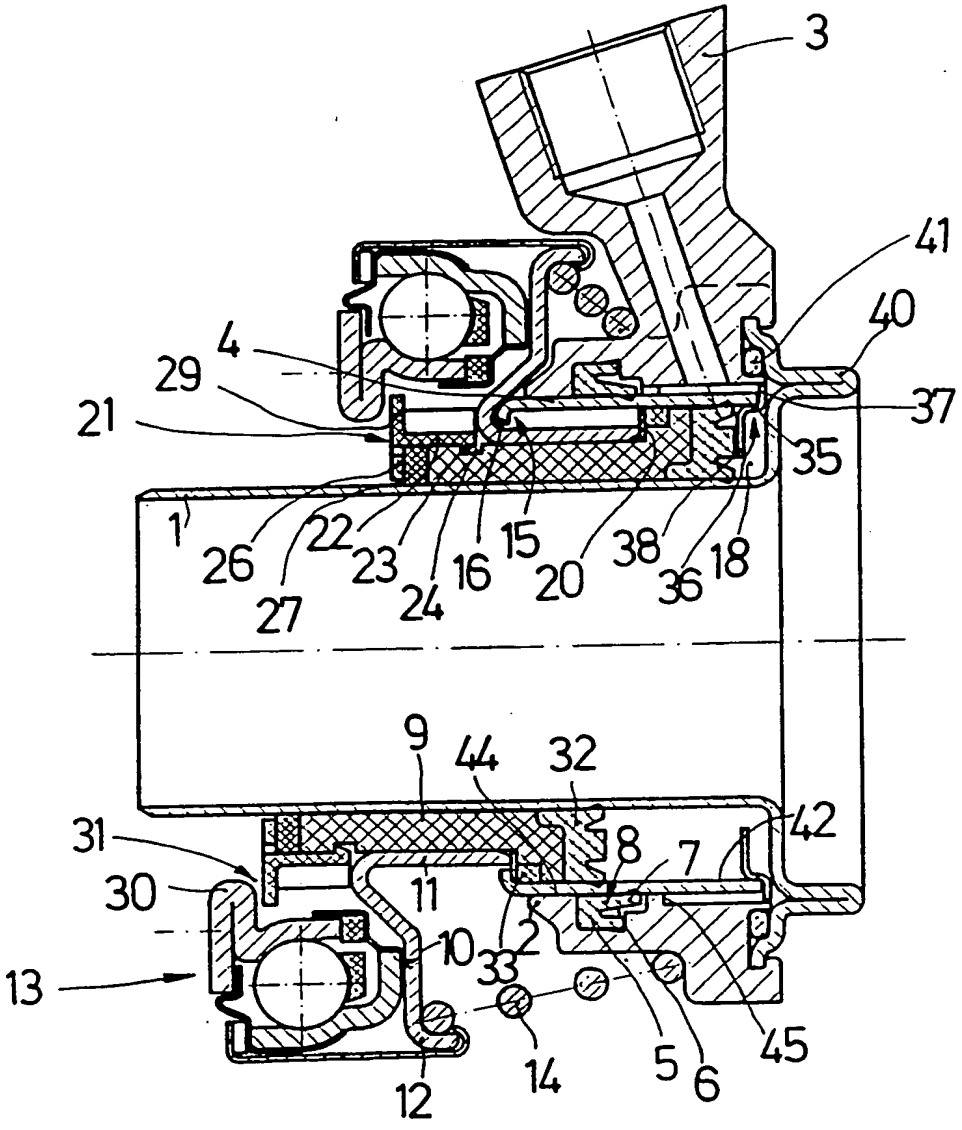


Fig. 3

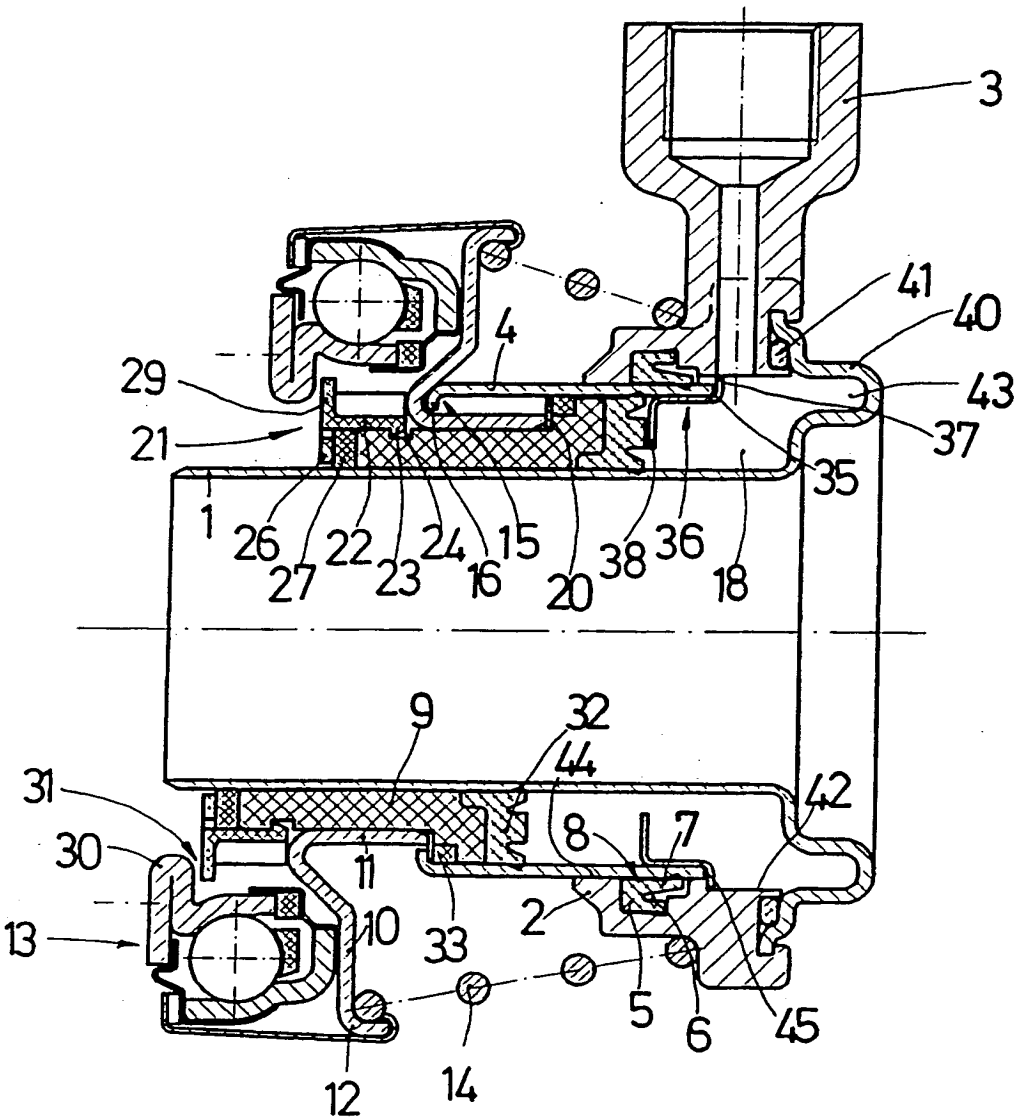
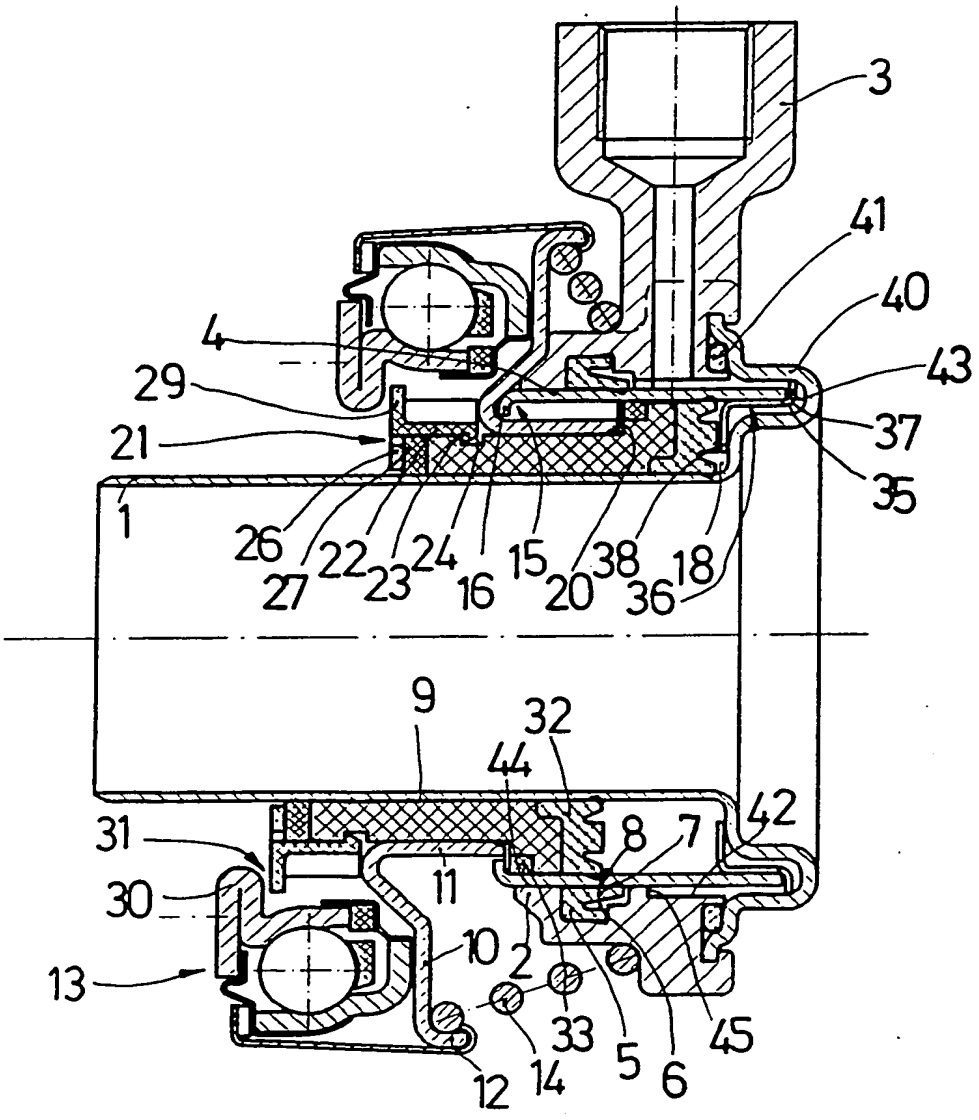


Fig. 4



HYDRAULICALLY ACTUATED WITHDRAWAL SYSTEM

The invention relates to an hydraulically actuated withdrawal system for a motor vehicle friction clutch of the kind comprising a piston and cylinder unit arranged concentrically relative to a vehicle gearbox input shaft, the cylinder being secured to a gearbox housing and having inner and outer cylinder casings, between which is defined a cylinder chamber of which pressurisation acts on the piston in order to effect clutch engagement and withdrawal, and a guiding element surrounding the piston and engaging with the piston and a surface of the outer cylinder casing.

Such a withdrawal system is known from DE-GM-93 13 557. The guiding element surrounding the piston guides the piston in a sealing manner with respect to the outer cylinder casing and accordingly must project sufficiently far in an axial direction beyond the piston to ensure that the sealed connection is also effective when the piston, with a new friction clutch, has its maximum degree of advance out of the cylinder chamber. Starting from this first extreme position, for engagement of the friction clutch, the piston performs a stroke into the cylinder chamber. As the friction clutch wears the engaging spring of the clutch displaces the piston further and further into the cylinder chamber until it finally achieves a second extreme position in which, on maximum wear of the friction clutch, it reaches its maximum inward depth of movement into the cylinder chamber. On account of the length of the guiding element, determined by adding the normal stroke and the wear-originating stroke of the piston, with given axial dimensions of the cylinder chamber, either the normal stroke of the piston must be restricted or there must be formed on the cylinder

housing, radially outside a shaft sealing ring arranged on the gearbox shaft, an annular axial recess for accommodating the guiding element. Limiting the movement of the piston is generally impossible as the travel is predetermined by the construction of the friction clutch. The provision of the annular recess is out of the question in motor vehicles in which, for reasons of structure, no space is available for such a recess. The known withdrawal system is consequently not suitable where a large piston travel is required in a vehicle which has restricted space available.

The invention is based on solving the problem of constructing a withdrawal system so that, whilst having a minimum axial extent, it has as large a travel as possible for the piston.

According to the present invention, in an hydraulically actuated withdrawal system for a motor vehicle friction clutch of the kind set forth, a restraining device is provided between the outer cylinder casing and the guiding element, the restraining device being adapted to hold the guiding element stationary relative to the outer cylinder casing on movement of the piston for clutch engagement and withdrawal, and to be disabled to allow movement of the guiding element relative to the outer cylinder casing on axial movement of the piston resulting from wear of the friction clutch.

The provision of the restraining device means that the guiding element on normal advance and retraction of the piston, behaves as a fixed component. The guiding element only moves axially when, on wear of the friction linings of the clutch, the piston is displaced by the engaging spring of the clutch - initiated by its

travel - deeper into the cylinder chamber and thereby, with the restraining device disabled, displaces the guiding element through an axial stroke, of which the length is dependent on the state of wear of the clutch. Now, starting from this new axial position of the guiding element, the piston performs its advance and retraction, its travel being shifted axially from its position when the clutch was new. As a result of this relationship of movement of the piston and the guiding element, which are radially offset and move within one another telescopically, the piston performs its travel along the radially inner surface of the guiding element, whilst the guiding element retracts with its radially outer surface moving with respect to the outer cylinder casing on wear of the clutch, through an amount which corresponds at a maximum to the total wear travel. The stroke of the piston is superimposed on the radially offset wear travel so that the total travel in the withdrawal system which results from the normal stroke and the wear travel is reduced, in comparison with the known system which requires an addition of these two travels, by the amount of overlap resulting from this superposition. The guiding element can thus be shortened so that it takes up less axial space in the cylinder chamber. Consequently the piston can accommodate large travels or strokes within a withdrawal system of compact external dimensions.

The restraining device can engage the guiding element in various different ways, such as for example through a rib or bead arrangement which extends perpendicular to the axial direction and engages a similar rib arrangement on the guiding element and on the action of a predetermined axial force permits a relative movement of the guiding element, with respect to the outer cylinder casing. Instead, the restraining

device may engage mechanically in a recess in the guiding element, and be capable of being released from this recess, for example by the action of an additional adjusting element, to perform an adjusting sequence on wear.

A particularly simple embodiment is where the restraining device is connected mechanically to the guiding element, and the force holding the guiding element against axial movement on clutch engagement and withdrawal is greater than the axial force exerted on the guiding element on axial displacement of the piston resulting from wear. Preferably the force holding the guiding element against axial movement when the cylinder chamber is unpressurised is less than the axial force exerted on the guiding element on axial displacement of the piston resulting from wear. Thus, it is only after completion of an engaging movement of the piston that the holding force falls below the axial force. It is particularly advantageous if the restraining device is formed by a seal which, on advance of the piston caused by pressurisation of the chamber, or on retraction of the piston causing recuperation of the pressure fluid, acts on the guiding element with a greater holding force against an axial movement than when the cylinder is unpressurised. Conveniently, the seal has a sealing lip which faces towards the fluid pressure connection and is acted on by the pressure fluid to engage the guiding element. This ensures that the radial holding force on advance and retraction of the piston out of and into the cylinder chamber is higher than when the chamber is unpressurised. When the chamber is unpressurised only the pre-stress in the seal is effective, whereas during piston advance and retraction the seal is also loaded by the fluid pressure which increases the force

holding it against the guiding element. This construction is also advantageous, because when the pressure fluid flows into the cylinder chamber not only the piston, but also the guiding element, is urged in an axial direction. If the guiding element were to be displaced axially by the pressure fluid the effective volume of the chamber would be increased by the amount of the exposed surface of the guiding element, which would increase the withdrawal force. Further because of the greater volume in the cylinder chamber, the stroke of the piston would be reduced as the amount of pressure fluid fed to the chamber is exactly measured to provide a given piston travel. It is therefore essential that movement of the guiding element on advance and retraction of the piston is prevented. This is the reason why, for this critical movement of the piston, the higher force between the seal and the guiding element is produced.

The piston is preferably guided in a sealing manner with respect to the guiding element. Conveniently the piston has at least in its radially outer region a fluid pressure seal engaging the guiding element. This prevents the escape of pressure fluid. Further the fluid pressure seal has an associated scraper ring engaging the guiding element. The entry of dust is prevented by the scraper ring.

Conveniently the guiding element has on its end adjacent the friction clutch a first stop for limiting the advance of the piston. Preferably, the stop is formed by a flange projecting towards the piston and against which a radial projection on the piston comes into engagement.

Further, the guiding element may have a second stop movable axially for a predetermined distance in a radially widened portion of the outer cylinder casing to prevent it emerging from the cylinder. The second stop is preferably formed by an annular member secured to the guiding element and having a radial projection for limiting the inward movement of the piston in the cylinder chamber. Especially in the new condition of the withdrawal system this second stop has the function, when the cylinder chamber is subjected to a vacuum before filling with fluid, of supporting the piston against the suction force exerted on the piston by the vacuum.

Preferably the piston carries a bearing ring for a withdrawal thrust race, the bearing ring having an axially extending portion engaging in the guiding element and a flange-like radially outwardly extending portion of which the side remote from the thrust race bears against the guiding element. The axially extending portion serves to receive the piston and can be retracted into the guiding element, and the flange-like radially outwardly extending portion serves as a stop for limiting the movement of the piston on engagement on the guiding element after a retraction movement of the piston. The end of the piston adjacent the thrust race may carry a securing element for preventing axial movement of the bearing ring. The securing element may have an axially projecting portion with a radial nose by which it can snap resiliently into a notch or recess in the piston. This connects it to the piston in a simple manner. The securing element may have on its end remote from the piston a radial inwardly extending portion for abutting against a scraper ring arranged between the inward portion and the piston. This prevents the penetration of dust

between the piston and the inner cylinder casing. Further, the securing element may have a radially outwardly extending portion located in an axial direction so as to leave only the width of a gap between it and a radially inwardly extending flange on the thrust race. It is therefore effective as a contactless gap seal by co-operation of its radial widened portion with a corresponding flange on the thrust race.

Conveniently, the cylinder has a housing which has on its side remote from the piston a mounting flange enclosing an annular-axially extending recess, the guiding element being able to move into the recess on axial displacement compensating for wear of the friction clutch. The outer dimensions of the withdrawal system in an axial direction can be further shortened for a given travel, because of the annular axial recess for receiving the guiding element. The guiding element, which only moves along a distance corresponding to the total wear travel of the clutch, can move into this recess.

Some preferred embodiments of the invention are illustrated by way of example in the accompanying drawings, which:

Figure 1 is a longitudinal section through an hydraulically actuated withdrawal system with a mounting flange on its gearbox end, showing the retracted and advanced positions taken up by the piston when the clutch is new;

Figure 2 is similar to Figure 1 but shows the retracted and advanced positions of the piston at the end of the wear life;

Figure 3 is similar to Figure 1 but shows a modified mounting flange which has an axial recess; and

Figure 4 is similar to Figure 2 but with the mounting flange in accordance with Figure 3.

The hydraulically actuated withdrawal system illustrated in Figures 1 and 2 comprises a piston and cylinder unit arranged concentrically relative to a gear input shaft of a motor vehicle (not shown). The cylinder comprises a radially inner cylinder casing 1 and a radially outer cylinder casing 2 on which a fluid pressure connection 3 is formed for connection to a cylinder chamber 18 adapted to act on the piston. A piston 9 slides on the radially outer surface of the inner casing 1. A sleeve-shaped guiding element 4 which is movable axially relative to the outer casing 2 surrounds the piston 9, and engages with the piston 9 and a guide surface 44 of the outer casing 2. A seal 5 is arranged in a recess 6 in the outer casing 2 and has a sealing lip on its side adjacent the element 4 and pointing towards the fluid pressure connection 3. The lip 7 of this seal 5 is radially pre-stressed and is pressed against the element 4 and thereby produces a mechanical connection between the outer cylinder casing 2 and the guiding element 4. By virtue of this the seal 5 acts as a restraining device 8 for the guiding element 4.

The guiding element 4 serves to guide the piston 9 which is movable for withdrawal and engagement in an axial direction relative to the element 4 and relative to the inner cylinder casing 1. The piston 9 carries a bearing ring 10 which has an axially projecting portion 11 lying radially inside the guiding element 4 and

parallel to it. The bearing ring 10 also has a flange-shaped radially outwardly extending portion 12 to which a clutch withdrawal bearing or thrust race 13 is secured on the clutch side, whilst a pre-loading spring 14 bears against the gearbox side and abuts with its other end against the casing 2. The spring 14 holds the thrust race 13 against the engaging spring of a friction clutch, not shown, but known for example from DE 32 41 248 A1. The gearbox side of the portion 12 of the bearing ring 10 is also engaged by a radial inward bead 16 on the guide element 4 forming a first stop 15 when the piston 9, as shown in the upper halves of Figures 1 and 2, is retracted within the cylinder chamber 18 defined by the outer and inner casings.

The bearing ring 10 is slid into the piston 9 in an axial direction and comes up against a shoulder 20 on it. To secure the bearing ring 10 against movement the other way the piston 9 has on its opposite axial end a securing element 21. The element 21 is annular, with an axially projecting portion 22 having on its free end a nose 23 which snaps resiliently into an associated notch 24 in the piston 9. The securing element 21 also has a number of radially inwardly projecting portions 26 which hold a scraper ring 27 for dust against the clutch end of the piston 9. In addition the securing element 21 has on its clutch end a radially outwardly extending portion 29 which approaches to within a clearance gap an inwardly projecting portion 30 on the thrust race 13, and in co-operation with this portion 30 it acts as a contactless gap seal 31.

The piston 9 is sealed by a seal 32 both with respect to the guiding element 4 and also with respect to the inner cylinder casing 1 to prevent the escape of

pressure fluid. The piston 9 also carries on its radially outer surface, adjacent the shoulder 20 and associated with the seal 32, a scraper ring 33 which prevents entry of dust. At the pressure side of the seal 32 there is a hoop member 35 secured to the guiding element 4 and having a bead 37 which projects radially outwards to form a second stop 36 for the guiding element 4. In addition there is provided on the hoop member 35 a radially inwardly directed flange 38 against which the seal 32 comes into engagement when the piston 9 is retracted into the chamber 18.

At its gearbox end, that is, the right hand end in Figures 1 and 2 the inner cylinder casing 1 surrounds a gearbox input shaft, not shown, and has a mounting flange 40 which is used to enclose a sealing ring arranged on the gearbox shaft. The inner cylinder casing 1 is connected through a scraper 41 to the outer cylinder casing 2.

The withdrawal system operates as follows. When the withdrawal system is combined with a new friction clutch the piston 9 takes up one of the two end positions illustrated in Figure 1 at any given time. The upper half of Figure 1 shows the clutch engaged position, in which the piston is retracted within the chamber 18, whilst the lower half of the Figure shows the advanced position of the piston 9 on clutch withdrawal. By comparison of the upper and lower halves of the Figure it is clear that during this inward and outward movement of the piston 9 the guiding element 4 does not move within the cylinder. This is achieved by the seal 5, since the sealing lip 7 is pre-stressed in a radial direction, to produce a forcible connection between the outer cylinder casing 2 and the guiding element 4. The forcible connection

prevents the guiding element 4 from moving with the piston 9 when the piston advances and retracts. As the sealing lip 7 points towards the fluid pressure connection 3, on advance of the piston 9 the sealing lip is exposed to the fluid pressure acting radially inwardly which is causing the advance, so that the sealing lip is urged against the guiding element 4 with a force many times its radial pre-stress. This ensures that the guiding element 4, despite the fluid pressure acting on its end adjacent the connection 3, does not move relative to the outer cylinder casing 2, and accordingly the volume of the chamber 18 remains constant. On retraction of the piston 9 the sealing lip 7 is similarly loaded and by the pressure fluid as it is forced out of the chamber 18 by the piston 9 on its retraction movement.

On pressurisation of the chamber 18 the piston 9 advances out of the cylinder until its shoulder 20, guided on the inner face of the guiding element 4, engages the first stop 15. Thus, the stop restricts the amount of advance of the piston 9. The piston is then in the advanced position shown in the lower part of Figure 1.

In a friction clutch such as in DE 32 41 248 A1, as is known, wear takes place between a pressure plate and friction linings of the clutch, so that the position of the engaging spring within the clutch housing produced by the engaging force changes. In clutches in which this alteration in the position of the spring causes a pressure on the thrust race 13 in a direction towards the gearbox end of the cylinder, an axial force is exerted on the guiding element 4 through the bearing 13 and the ring 10, this force being greater than the force that the restraining device 8

exerts on the guiding element 4 to hold it stationary, when with the cylinder unpressurised the sealing lip 7 acts on the guiding element 4 only with its own radial pre-stress. As a result, when the cylinder is unpressurised the axial force applied through the bearing 13 displaces the guiding element 4 towards the gearbox end of the cylinder until the change in position caused by the wear is balanced by the engaging spring of the clutch. As soon as a new balance of forces is obtained, the guiding element 4 stops. Starting from this new position of the guiding element 4 the piston 9 now performs its retracting and advancing movement with the usual length of stroke.

On continued operation of the withdrawal system progressively increasing wear causes the guiding element 4 to be moved progressively towards the gearbox end of the cylinder, until it reaches its end position illustrated in Figure 2. Even in this end position of the guiding element 4 the piston 9 still performs its usual length of stroke.

The hoop member 35 secured to the free end of the guiding element 4 acts as a second stop 36 through its radially outwardly directed bead 37. When the clutch is new as in Figure 1, the bead 37 abuts against a radial projection 45 on the outer cylinder casing 2 and thereby prevents the guiding element 4 sliding out of the cylinder casing 2. On increasing wear of the clutch this second stop 36 moves in the guide 42, provided for it in the cylinder casing 2, in the direction of the gearbox. The projection 38 on the hoop member 35 is operative only on filling of the cylinder with fluid pressure medium. Before the cylinder chamber 18 is filled, it is normally subjected to a vacuum, which causes the piston 9 to be retracted

into the cylinder chamber 18 where it comes up against the stop 38. The fluid can then be introduced into the cylinder without any problem. If necessary any air bubbles are conducted to the exterior through a venting pipe, not shown.

The mounting flange 40 provides the cylinder with a radial guide for introducing it into the gearbox housing, not shown. The construction of the mounting flange of Figures 1 and 2 is employed in particular when a particularly large shaft sealing ring is to be mounted on the gearbox shaft radially inwardly of the flange. When a smaller shaft sealing ring is required, the embodiment of the withdrawal system illustrated in Figures 3 and 4 is particularly advantageous. In this arrangement the mounting flange 40 is provided with an internal axially extending annular recess 43 which receives the guiding element 4 as it moves as a result of wear. In such a construction of the mounting flange 40, in comparison with the withdrawal system of Figures 1 and 2, either the piston travel on engagement and withdrawal can be increased or alternatively, using the piston travel comparable with Figures 1 and 2 the withdrawal system can be further shortened in an axial direction. The relationship between piston travel and axial extent of the piston consequently reaches an optimum in this embodiment.

As in Figures 1 and 2, the withdrawal system is shown in Figure 3 as it would be with a new clutch and with Figure 4 with a worn clutch. The construction and operation of the embodiment of Figures 3 and 4 are otherwise the same as that of Figures 1 and 2, and corresponding reference numerals have been applied to corresponding parts.

CLAIMS

1. An hydraulically actuated withdrawal system for a motor vehicle friction clutch of the kind set forth in which a restraining device is provided between the outer cylinder casing and the guiding element, the restraining device being adapted to hold the guiding element stationary relative to the outer cylinder casing on movement of the piston for clutch engagement and withdrawal, and to be disabled to allow movement of the guiding element relative to the outer cylinder casing on axial movement of the piston resulting from wear of the friction clutch.

2. A withdrawal system as claimed in claim 1, in which the restraining device is connected mechanically to the guiding element, and the force holding the guiding element against axial movement on clutch engagement and withdrawal is greater than the axial force exerted on the guiding element in axial displacement of the piston resulting from wear.

3. A withdrawal system as claimed in claim 1 or claim 2, in which the force holding the guiding element against axial movement when the cylinder chamber is unpressurised is less than the axial force exerted on the guiding element on axial displacement of the piston resulting from.

4. A withdrawal system as claimed in any preceding claim, in which the restraining device is formed by a seal which, on advance of the piston caused by pressurisation of the chamber, or on retraction of the piston causing recuperation of the pressure fluid, acts on the guiding element with a greater holding force

against an axial movement than when the cylinder is unpressurised.

5. A withdrawal system as claimed in claim 4, in which the seal has a sealing lip which faces towards the fluid pressure connection and is acted on by the pressure fluid to engage the guiding element.

6. A withdrawal system as claimed in any preceding claim, in which the piston is guided in a sealing manner with respect to the guiding element.

7. A withdrawal system as claimed in claim 6, in which the piston has at least in its radially outer region a fluid pressure seal engaging the guiding element.

8. A withdrawal system as claimed in claim 7, in which the fluid pressure seal has an associated scraper ring engaging the guiding element.

9. A withdrawal system as claimed in any preceding claim, in which the guiding element has on its end adjacent the friction clutch a first stop for limiting the advance of the piston.

10. A withdrawal system as claimed in claim 9, in which the stop is formed by a flange projecting towards the piston and against which a radial projection on the piston comes into engagement.

11. A withdrawal system as claimed in any preceding claim, in which the guiding element has a second stop movable axially for a predetermined distance in a radially widened portion of the outer cylinder casing to prevent it emerging from the cylinder.

12. A withdrawal system as claimed in claim 11, in which the second stop is formed by an annular member secured to the guiding element and having a radial projection for limiting the inward movement of the piston in the cylinder chamber.

13. A withdrawal system as claimed in any preceding claim, in which the piston carries a bearing ring for a withdrawal thrust race, the bearing ring having an axially extending portion engaging in the guiding element and a flange-like radially outwardly extending portion of which the side remote from the thrust race bears against the guiding element.

14. A withdrawal system as claimed in claim 13, in which the end of the piston adjacent the thrust race carries a securing element for preventing axial movement of the bearing ring.

15. A withdrawal system as claimed in claim 14, in which the securing element has an axially projecting portion with a radial nose by which it can snap resiliently into a notch or recess in the piston.

16. A withdrawal system as claimed in claim 14 or claim 15, in which the securing element has on its end remote from the piston a radial inwardly extending portion for abutting against a scraper ring arranged between the inward portion and the piston.

17. A withdrawal system as claimed in any of claims 14 to 16, in which the securing element has a radially outwardly extending portion located in an axial direction so as to leave only the width of a gap between it and a radially inwardly extending flange on the thrust race.

18. A withdrawal system as claimed in any preceding claim, in which the cylinder has a housing which has on its side remote from the piston a mounting flange enclosing an annular axially-extending recess, the guiding element being able to move into the recess on axial displacement compensating for wear of the friction clutch.

19. An hydraulically actuated withdrawal system for a motor vehicle friction clutch of the kind set forth substantially as described herein with reference to and as illustrated in Figures 1 and 2 of the accompanying drawings.

20. An hydraulically actuated withdrawal system for a motor vehicle friction clutch of the kind set forth substantially as described herein with reference to and as illustrated in Figures 3 and 4 of the accompanying drawings.

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Patents Act 1977
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(ii) Int Cl (Ed.6) F16D 25/08, 25/12

Search Examiner
MIKE McKINNEY

Date of completion of Search
2 JUNE 1995

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE: WPI

Documents considered relevant following a search in respect of Claims :-
1 TO 20

Categories of documents

X: Document indicating lack of novelty or of inventive step.

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A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
A	GB 2096262 A	(AUTOMOTIVE PRODUCTS)	
A	GB 1544814	(AUTOMOTIVE PRODUCTS)	
A	WO 94/07047 A1	(AUTOMOTIVE PRODUCTS)	

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